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ASSESSMENT OF GENETIC VARIABILITY AND HERITABILITY IN SEGREGATING POPUATIONS

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ABSTRACT

The present study was carried out to assess the genetic variability, heritability, genetic advance for yield and yield component characters in two cross viz., BPT 5204 X ADT 45 and BPT 5204 X JGL 1798. In general, most of the characters viz., plant height, number of productive tillers, filled grains per panicle, spikelet fertility, 1000 grain weight, seed yield per plant, grain length, grain width and L/B ratios in cross BPT 5204 X ADT 45 having higher mean performance when compared with the cross BPT 5204 X JGL 1798. High PCV and GCV showed high heritable variation which was recorded high in the characters viz., productive tillers per plant, and sterile grains per panicle and grain yield per panicle in both the crosses. Selection may be effective for the character with high heritability accompanied with high genetic advance which indicated that the heritability is due to additive gene effects. Similarly, high heritability with high genetic advance was observed for grain width in cross BPT 5204 X ADT 45 and the characters grain breadth and L/B ratios in cross BPT 5204 X JGL 1798.

KEYWORDS: Rice, Variability, PCV, GCV, Heritability & Genetic Advance

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Original Article

INTRODUCTION

Rice is the most important crop among the cereals grown in India and the world. Rice is considered as the "Global grain" because of more than half of the global population used as staple food. Asia is considered to be "rice bowl" of the world, and it produces and consumes more than 90 per cent of world rice. A quantum jump in yield improvement has been achieved in rice with the development of high yielding heterotic hybrids under commercial cultivation. So, it is critical to produce high yielding cultivars with high quality by inbreeding methods. The study of genetic variability is the pre-requisite for any crop improvement program. Genetic variability studies provide basic information regarding the genetic parameters of the population based on which breeding methods are formulated for further improvement of the crop. Heritability estimates of quantitative characters play an important role in expressing the reliability of variance value as a selection guideline to the plant breeder. Heritability along with genetic advancement should be jointly considered to arrive at a more reliable conclusion (Johnson *et al*., 1955). Selection on the basis of grain yield character alone is usually not very effective and efficient. However, selection based on its components and secondary characters could be more efficient and reliable. The genetic variation such as PCV, GCV, heritability and genetic advances would benefit breeders in designing the most appropriate breeding approaches for developing a rice variety. The present study was formulated to study the genetic variability of yield and its contributing characters in segregating populations (F2) of two different crosses.

MATERIALS AND METHODS

The present experiment was carried out at Rasi Seeds (P) Ltd., Attur, Salem, located at 22^0 57' N latitude and 72^0 54' E longitudes at an altitude of 119.8 m above the mean sea level. The soil of the experimental site is heavily black and fine textured with pH ranges from 7. 5 to 8.0. It receives an average annual rainfall of 760 mm. The materials comprised of three parental lines *viz*., BPT 5204, ADT45, JGL 1798 obtained from Germplasm divisions of Rasi Seeds (P) Ltd. By using these three lines, two different crosses BPT 5204 X ADT 45 and BPT 5204 X JGL 1798 were made during *kharif'13*. The F_1 seeds from the above two crosses were raised during *rabi'13.* Parental lines and F_1's were saved during the same season to obtain seeds of parental lines and F_2's. The F_2 plants from each cross along with three parents as a check were raised during *kharif'14* by adopting a spacing of 15 X 10 cm with single seedling per hills in non-replicated plots. All the recommended package of practices formulated by TNAU was followed along with necessary prophylactic plant protection measures to raise a good crop. Exhibited mean performance for biomedical traits in F2 generations for almost all the economic characters, including yield among the two crosses BPT 5204 X ADT 45 and BPT 5204 X JGL 1798 were observed. Data were recorded for 200 plants in the F2's respectively, for days to 50 percent flowering (days), plant height (cm), number of productive tillers per plant, panicle length (cm), number of filling grains per panicle, number of grains per panicle, spikelet fertility, grain length (mm), grain breadth (mm), grain width (mm), L/B ratio, amylase content, Alkaline spreading value, 1000 grain weight (g) and Grain yield per plant in single plant observation. These data were subjected to statistical analysis. Standard statistical procedure was used for the analysis of genotypes and phenotypes coefficients of variation (Burton, 1952), heritability (Lush, 1940) and genetic advance.

RESULTS AND DISCUSSIONS

The importance of variability in early segregations was given by Sivasubramanian and Mathavemenon (1973). The performance of the cross is estimated not only by using mean performance, but also on the extent of variability. Successful crop breeding lies in knowledge on the nature and magnitude of genotypic and phenotypic variation (Allard, 1960). In the present study, considerable variations were observed in the mean performance of the F_2 populations over two crosses *viz.,* BPT 5204 X ADT 45 and BPT 5204 X JGL 1798 for 15 different characters. The range of variation was higher in cross A compared with cross B which depicted in figure 1.

High mean values always remain as main and the simplest selection index in the choice of genotypes (Pachel, 2014). Between two crosses, the high mean value of seed yield per plant in the cross BPT 5204 X ADT 45 was 25.67 cm with the range of 7.0 GM and 46.0 GM. Similarly, high mean performance was seen in the cross BPT 5204 X ADT 45 for the character 1000 grain weight (15.22 GM), plant height (101.75 cm), number of productive tillers per plant (15.82), filled grains per panicle (219.38), spikelet fertility (81.61%), grain length (7.46 mm), grain width (1.75mm) and a L/B ratio (3.41) than the BPT 5204 X JGL 1798. The mean performance of the characters *viz.,* panicle length (21.86 cm), number of grains per panicle (273.03), grain breads (2.25 mm), amylase content (23.29%) and alkaline spreading values (3.58) were recorded more in the BPT 5204 X JGL 1798. In general, BPT 5204 X ADT 45 had a high mean performance for most of the characters and had low sterile grains per panicle (51.54) and was early (Days to 50% flowering – 93.92 days) than the BPT 5204 X JGL 1798.

In the present study, the phenotypes variances were greater than the genotypic variance for all the characters studied in F_2 populations of both the crosses. This indicated that the environment has a greater influence on all the characters studied. The phenotypic coefficient of variation (PCV) was higher than the genotype coefficient of variation

(GCV) in both the populations which also indicated that higher environmental influence on the expression of all the characters. High PCV and GCV were observed for productive tillers per plant, sterile grains per panicle, grain yield per panicle in both the population and filled grains per panicle in F_2 populations of cross A. This showed that the variations observed in these characters contributed markedly to the total variability. High PCV and moderate GCV were observed for the number of grains per panicle in cross A. Selection will be effective based on the heritable nature of that character. Panicle length in cross A and the grain breads in cross B had moderate PCV and low GCV. Moderate PCV and GCV were recorded in plant height, spikelet fertility, alkaline spreading value in both the crosses and the characters such as amylase content in cross A and also the characters, filled grains per panicle, number of grains per panicle, L/B ratios in cross B. The characters *viz*., 50% flowering, 1000 grain weight, grain length and grain width in both the cross A and B and grain breads and L/B ratio in cross A and also the characters panicle length and amylose content in cross B recorded low PCV and GCV. This indicated that the variability of these characters among these populations was meager.

The present investigation revealed that all the 15 characters showed high heritability in segregating populations of both the crosses, except grain breadth, which had moderate heritability in cross A. Heritability in conjugation with genetic advance is more effective and reliable in predicting the resultant effect of selection and based on which, selection procedure can be evaluated. According to Panse (1967), such characters were found to be governed by additive gene action. The results indicated the presence of additive gene effects and consequently a high genetic gain could be expected from phenotypic selection. High heritability with high genetic advance was observed for grain width in cross A and the characters grain breadth and L/B ratios in cross B. High heritability accompanied with high genetic advance indicated that most likely the heritability is due to additive gene effects and the selection may be effective for these characters.

CONCLUSIONS

Highly heritable with moderate genetic advance was observed in productive tillers per plant, alkaline spreading value and grain yield per plant in segregating populations of both crosses A and B and the characters such as sterile grains per panicle, grain breads and amylose content in Cross A and also the character grain width in cross B also having similar effect. High heritability with low genetic advance was observed in days to 50% flowering, plant height, panicle length, filled grains per panicle, number of grains per panicle, spikelet fertility, grain length, amylose content and grain yield per plant in both the crosses and sterile grains in cross B. High heritability with low genetic advance was observed for days to maturity in summer season. It is an indication for non-additive gene action for the above mentioned characters. High heritability was due to conducive environment, rather than genotypic and selection of such characters may not be rewarding.

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APPENDICES

Table 1: Mean Performance and Range in F2 Population of Crosses BPT 5204 X ADT 45 and BPT 5204 X JGL 1798

S. No.	Characters	Cross Details	Min	Max	Mean	PCV	GCV	h^2	GAM
1	**Days to 50 % flowering**	BPT 5204 X ADT 45	80.00	109.00	93.92	7.22	7.16	98.40	2.01
		BPT 5204 X JGL 1798	77.00	110.00	94.24	7.68	7.64	99.00	1.86
2	**Plant height (cm)**	BPT 5204 X ADT 45	71.50	137.00	101.75	11.00	10.69	94.36	3.12
		BPT 5204 X JGL 1798	65.90	121.00	94.67	11.63	11.15	92.00	3.53
3	**Number of productive tillers /plant**	BPT 5204 X ADT 45	9.00	31.00	15.82	23.06	20.39	78.20	13.29
		BPT 5204 X JGL 1798	8.00	26.00	14.83	23.77	20.07	71.27	13.61
4	**Panicle length (cm)**	BPT 5204 X ADT 45	16.90	29.00	21.86	11.14	9.73	76.39	7.83
		BPT 5204 X JGL 1798	17.50	26.50	22.20	8.95	8.30	86.03	6.88
5	**Filled grains/Panicle**	BPT 5204 X ADT 45	84.00	342.00	219.38	22.95	20.96	83.40	3.55
		BPT 5204 X JGL 1798	154.00	312.00	217.23	16.65	13.80	68.73	2.93
6	**Sterile grains/Panicle**	BPT 5204 X ADT 45	10.00	197.00	51.45	73.23	60.67	68.64	12.62
		BPT 5204 X JGL 1798	13.00	165.00	55.80	58.48	57.50	96.66	8.71
7	**Number of grains /panicle**	BPT 5204 X ADT 45	133.00	459.00	270.83	23.16	19.14	68.32	3.09
		BPT 5204 X JGL 1798	177.00	437.00	273.03	18.11	15.78	75.84	2.82
8	**Spikelet fertility (%)**	BPT 5204 X ADT 45	53.11	95.94	81.61	12.73	10.02	61.87	3.96
		BPT 5204 X JGL 1798	52.98	93.43	80.27	10.84	10.56	94.89	3.42
9	**1000 grain weight (g)**	BPT 5204 X ADT 45	12.50	18.20	15.22	6.99	6.97	99.52	3.66
		BPT 5204 X JGL 1798	12.40	18.60	15.12	6.21	6.19	99.50	3.5
10	**Seed yield /plant (gm)**	BPT 5204 X ADT 45	7.00	46.00	25.67	35.73	29.53	68.31	12.46
		BPT 5204 X JGL 1798	7.00	46.00	24.73	33.61	32.46	93.27	11.41
11	**Grain Length (mm)**	BPT 5204 X ADT 45	6.25	8.25	7.46	4.98	4.26	72.92	8.86
		BPT 5204 X JGL 1798	6.30	8.34	7.30	6.21	5.85	88.76	9.77
12	**Grain Breadth (mm)**	BPT 5204 X ADT 45	1.83	2.75	2.21	8.27	6.04	53.37	17.58
		BPT 5204 X JGL 1798	1.45	2.87	2.25	11.72	9.52	66.08	23.72
13	**Grain Width (mm)**	BPT 5204 X ADT 45	1.45	1.98	1.75	5.82	5.20	79.86	20.09
		BPT 5204 X JGL 1798	1.40	1.98	1.72	6.05	5.03	68.97	19.9
14	**L/B Ratio**	BPT 5204 X ADT 45	2.77	4.04	3.41	8.22	7.14	75.49	16.99
		BPT 5204 X JGL 1798	2.38	5.38	3.29	12.03	10.07	70.15	20.44
15	**Amylose content (%)**	BPT 5204 X ADT 45	17.50	26.50	22.80	10.21	10.13	98.37	4.85
		BPT 5204 X JGL 1798	18.00	26.80	23.29	8.58	8.31	93.69	5.87
16	**Alkaline Spreading Values**	BPT 5204 X ADT 45	3.00	4.30	3.58	10.80	10.29	90.76	17.91
		BPT 5204 X JGL 1798	3.00	4.30	3.67	10.43	10.03	92.42	16.84